

Appl. No. : 10/500,494
Filed : December 28, 2002

AMENDMENTS TO THE CLAIMS

Please amend Claims 1-3, 5-7, 9-13 and 15-17.

Please cancel Claims 4, 8, 14 and 18-20.

Please add new Claims 21-28.

1. (Currently amended) A method for forming copper interconnection conductors for interconnecting integrated circuits on a substrate, comprising ~~the steps of~~ :

forming a barrier layer using ruthenium (Ru) or rhenium (Re) or their alloys on ~~[[the]]~~ a surface of an insulation layer on said substrate ~~[[by]]~~ using an atomic layer deposition (ALD) method~~[[,]]~~ ; and

forming a copper layer on ~~top of~~ said barrier layer using chemical vapor deposition (CVD).

2. (Currently amended) The method of claim 1, wherein said barrier layer is formed of a ruthenium (Ru) alloys contain alloy having an atomic ratio of at least 50% or more ~~[[of]]~~ ruthenium (Ru).

3. (Currently amended) The method of claim 1, wherein ~~in place of~~ said atomic layer deposition method~~[[,]]~~ is a plasma-enhanced atomic layer deposition (PEALD) method ~~is used~~.

4. (Canceled)

5. (Currently amended) The method of claim 1, wherein forming said copper layer ~~of thin film is formed using a chemical vapor deposition method with a treatment of~~ comprises using iodine or an iodine compound as a catalyst for CVD.

6. (Currently amended) The method of claim 1, wherein forming said copper layer ~~of thin film is formed by~~ further comprises using an electroplating method.

7. (Currently amended) The method of claim ~~[[1]]~~ 6, wherein forming said copper layer ~~of thin film is formed by~~ comprises sequentially using ~~a chemical vapor deposition method and an electro-plating CVD followed by the electroplating method~~.

8. (Cancelled)

9. (Currently amended) The method of claim ~~[[8]]~~ 1, wherein said barrier layer is formed of a rhenium alloys contain alloy having an atomic ratio of at least 50% or more ~~[[of]]~~ rhenium.

10. (Currently amended) A method for forming copper interconnection conductors for interconnecting integrated circuits on a substrate, comprising ~~the steps of~~;

forming a barrier layer on the surface of a patterned insulation layer on ~~[[a]]~~ the substrate~~[[,]]~~ ;

forming an adhesion layer on said barrier layer using ruthenium (Ru) or ~~ruthenium~~ rhenum (Re) or their alloys ~~[[by]]~~ using an atomic layer deposition method~~[[,]]~~ ; and

forming a copper layer ~~of thin film on the~~ on a surface of said adhesion layer, wherein forming said copper layer comprises using chemical vapor deposition (CVD).

11. (Currently amended) The method of claim 10, wherein said barrier layer is formed ~~using one of the materials including~~ of material selected from the group of TiN, Ta, TaN, TaNC, WN, WNC, Ti—Si—N~~[[,]]~~ and Ta—Si—N.

12. (Currently amended) The method of claim 10, wherein said ~~ruthenium (Ru) alloys~~ contain adhesion layer is formed of a ruthenium (Ru) alloy having an atomic ratio of at least 50% or more ~~[[of]]~~ ruthenium (Ru).

13. (Currently amended) The method of claim 10, wherein ~~in place of~~ said atomic layer deposition method~~[[,]]~~ is a plasma-enhanced atomic layer deposition method ~~is used.~~

14. (Canceled)

15. (Currently amended) The method of claim 10, wherein forming said copper layer ~~of thin film is formed using a chemical vapor deposition method with a treatment of~~ comprises using iodine or an iodine compound as a catalyst for CVD.

16. (Currently amended) The method of claim 10, wherein forming said copper layer ~~of thin film is formed by~~ further comprises using an electroplating method.

17. (Currently amended) The method of claim ~~[[10]]~~ 16, wherein forming said copper layer ~~of thin film is formed by~~ comprises sequentially using ~~a chemical vapor deposition method~~ CVD followed by and an the electroplating method.

18.-20. (Cancelled)

21. (New) The method of claim 1, wherein using CVD comprises using a fluorine-containing copper precursor.

22. (New) The method of claim 1, wherein using CVD comprises using a carbon-containing copper precursor.

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23. (New) The method of claim 1, wherein using CVD comprises using a copper precursor comprising hexafluoroacetylacetonate (hfac).

24. (New) The method of claim 23, wherein said copper precursor includes (hexafluoroacetylacetonate)Cu(vinyltrimethylsilane), or (hfac)Cu(vtms).

25. (New) The method of claim 10, wherein using CVD comprises using a fluorine-containing copper precursor.

26. (New) The method of claim 10, wherein using CVD comprises using a carbon-containing copper precursor.

27. (New) The method of claim 10, wherein using CVD comprises using a copper precursor comprising hexafluoroacetylacetonate (hfac).

28. (New) The method of claim 27, wherein said copper precursor includes (hexafluoroacetylacetonate)Cu(vinyltrimethylsilane), or (hfac)Cu(vtms).